BUILDING AN ON-DEMAND WATER SOLUTION FOR THE CITY OF HARARE

An initiative that is tackling the water crisis in Harare, by bringing together, coders, ethical hackers , designers, artists and makers from Amsterdam, Vienna, Pittsburgh & Harare through a virtual & hands-on workshop for building a sustainable water solution.

#H&D_HARARE

Proudly funded by Hackers & Designers Amsterdam, a non-profit workshop initiative organizing activities at the intersection of technology, design and art.

About Author

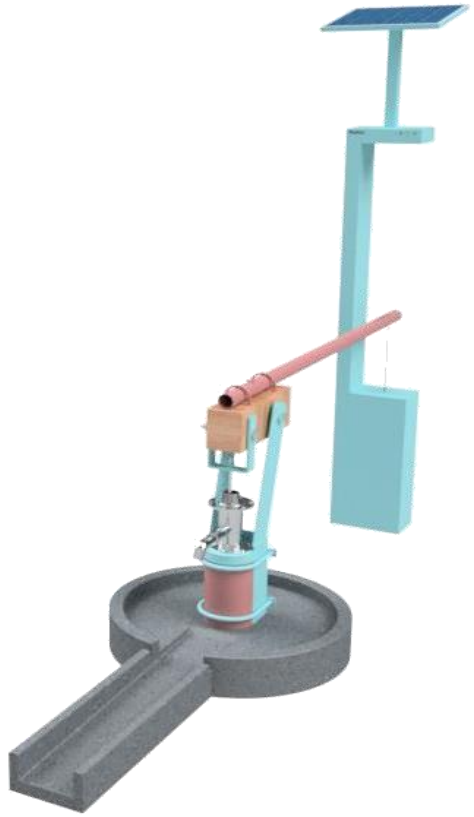
Bongani Ricky Masuku is an industrial designer , passionate about disrupting the agriculture industry for the better. One of the challenges he noticed was the water crisis in both rural and urban areas. To help solve the problem he developed Roko, a solar powered mechanism that automates the required hand powered action for the conventional water pumps in Zimbabwe. As part of this year's H&D Summer Academy edition, he's compiled this workshop proposal in order to foster collaborative efforts in solving the water crisis through working with H&D chapters in other countries. During the workshop event the Roko demo unit will serve as the base technology for participants to explore different ways on how we can solve the water challenge through both virtual & practical sessions.

Our Challenge

- 50% of the total residents in Harare,Zimbabwe go for months without access to water.
- Harare Municipality has no capacity to meet water requirements of the ever-growing population
- Harare City Council facing challenges with the cost of importing water purification chemicals & technologies
- Lack of access of water is causing water sanitation challenges for urban communities with no access to water

Progressive Workshop Format

The workshop sessions, are sub-divided into modular units crafted to help increase positive impact of the Roko technology, implemented through collaborative action from the H&D chapters towards the water crisis in Harare.
The pre-workshop activities involve conducting surveys & as well as collecting petitions from the community which are to be submitted to the Harare council. This will also include the procurement of materials & fabrication of the Roko demo unit through engaging the local experts, in borrowing their know-how & experience for building a sustainable water solution.
During Day 1 the remote chapters will be involved in different exercises whose results will be published to the Harare chapter, which they will use during their practical session in Day 2.
Day 3 will be fun & engaging session, whereby all chapters will come together during a live stream session, as they witness their work being implemented on the Roko demo unit, at the community borehole in Helensvale, Harare. Prospective partners will be invited for scaling the solution through their organizations to other communities both rural & urban.



17 PARTNERSHIPS FOR THE GOALS

6 CLEAN WATER AND SANITATION

Day 1: Virtual Session

Chapter(s): Vienna, Amsterdam Pittsburgh
Activity : Coding & Simulation
NB: Code published to Harare chapter

Day 2: Practical Session

Chapter(s): Harare
Activity : Prototyping & testing
NB: Test results published in video format to other chapters

Day 3: Demo Day

Chapter(s): Harare, Amsterdam, Pittsburgh, Vienna
Activity : Deploying the prototype modules on the Roko Demo unit
NB: Activity to be live-streamed to other chapters

Open-source Tools

ARDUINO Blynk ubidots

Pre-workshop Activities

9 May –

- Register participants for the workshop, with a limit of 20 (as set by the local authority)
- Identify at least (5) **suburbs** , where there is persistent water challenge. Divide participants into groups and task them to conduct surveys & collect petitions from each affected suburb.
- Engage their **local municipality** with a proposition to implement the first pilot unit in effort to impact the community.

  Pilot suburb : Helensvale, Harare.
- Commence procurement of materials for Roko demo unit .
- Fabricate the demo unit within the local community at a negotiated service fee.
- Arrange venue for the workshop & necessary requirements.
- Engage Netrozim (local Electronics Hobbysit Shop) as a partner who will rent us the required electronic kits for the successful implementation of the workshop.
- We'll now be set & ready for making sustainable impact through the workshop

Exploring different ways
Of fetching water with ease

Workshop pre-requisites:
Workshop Manual, Arduino IDE, Arduino Simulator

Session 1 : Introduction (10-15 minutes)

We look at the background research of the water crisis in Harare, how the locals continue to struggle to access water with ease. Afterwards We then look at the tools we'll be using, how they can help us achieve our goal for the day

Session Format : A guideline format for each exercise for the Virtual workshop (Duration: 60-90 minutes)

NB: The session format is the standard guideline for each Activity to be executed

Activity 1.1: Reviewing the Activity manual & setting up your workspace (10-15 minutes)

Activity 1.2 : Building the embedded source code & compiling to check for errors. (30-45 minutes)

Activity 1.3 : Setting up your Arduino simulator with virtual components according to manual (15 – 20 minutes)

Activity 1.4 : Testing your source code in the Arduino simulator

Start time: 10:30 am **End time: 12:30 am**

WORKSHOP DAY 1

Morning Activity

SESSION 1

Goal : Fetching underground water using a simple button **(60-90 minutes)**
Challenge: How to automate access to underground water
H&D Chapter: Vienna, Austria
Objectives 1: Building embedded source code deploying using Arduino simulator
Objective 2: Publish source code to Harare Chapter

SESSION 2

Goal : Mitigating water usage using a soil moisture **(60-90 minutes)**
Challenge: Regulating water usage in farming activities
H&D Chapter: Amsterdam, Netherlands
Objectives 1: Building & testing source code using Arduino simulator
Objective 2: Publish source code to Harare Chapter

SESSION 3

Goal : Monitoring water usage using an LCD output **(60-90 minutes)**
Challenge: Raising awareness in daily water usage
H&D Chapter: Pittsburgh, U.S.A.
Objectives 1: Building & testing source code using Arduino simulator
Objective 2: Publish source code to Harare Chapter

WORKSHOP
DAY 1

Afternoon Activity

SESSION 1

Goal : Securing the community borehole using using an alarm system **(60-90 minutes)**
Challenge: How to mitigate vandalism at the borehole & reduce down-time
H&D Chapter: Vienna, Austria
Objectives 1: Building embedded source code deploying using Arduino simulator
Objective 2: Published source code to Harare Chapter

SESSION 2

Goal : Fetching water using a real-time clock module **(60-90 minutes)**
Challenge: How to save time by accessing water a scheduled intervals
H&D Chapter: Amsterdam, Netherlands
Objectives 1: Building & testing source code using Arduino simulator
Objective 2: Published source code to Harare Chapter

SESSION 3

Goal : Building a smart tap using an ultra-sonic sensor **(60-90 minutes)**
Challenge: To sanitize manual shared water taps by making them contact-less
H&D Chapter: Pittsburgh, Netherlands
Objectives 1: Building & testing source code using Arduino simulator
Objective 2: Published source code to Harare Chapter

Start time: 1:30 pm

End time: 3:30 pm

Exploring different ways
Of fetching water with ease
Practical Workshop

Workshop pre-requisites:
Workshop Manual, Arduino IDE, Arduino Simulator

Session 1 : Introduction (10-15 minutes)

We look at the background research of the water crisis in Harare. Afterwards We then preview the work contributed by the other sessions & implement In a practical set-up by building prototype modules.

Session Format : A guideline format for each exercise for the Virtual workshop (Duration: 60-90 minutes)

NB: The session format is the standard guideline for each Activity to be executed

Activity 1.1: Reviewing the Activity manual & contributions from other chapters (10-15 minutes)

Activity 1.2 : Setting up the prototype & testing with different variables. (30-45 minutes)

Activity 1.3 : Publishing the test results of the trial run as feedback to the chapters who contributed

Start time: 11:30 am **End time: 12:30 am**

WORKSHOP
DAY 2

Morning Activity

SESSION 1

Goal : Fetching underground water using a simple button **(60-90 minutes)**

Challenge: How to automate access to underground water

H&D Chapter: Harare

Objectives 1: Setting up the prototype & testing using different variable conditions

Objective 2: Send feedback to the remote chapters in video format

SESSION 2

Goal : Mitigating water usage using a soil moisture **(60-90 minutes)**

Challenge: Regulating water usage in farming activities

H&D Chapter: Harare

Objectives 1: Setting up the prototype & testing using different variable conditions

Objective 2: Send feedback to the remote chapters in video format

SESSION 3

Goal : Monitoring water usage using an LCD output **(60-90 minutes)**

Challenge: Raising awareness in daily water usage

H&D Chapter:H

Objectives 1: Setting up the prototype & testing using different variable conditions

Objective 2: Send feedback to the remote chapters in video format

Exploring different ways
Of fetching water with ease

WORKSHOP
DAY 2

Afternoon Activity

SESSION 1

Goal : Securing community water sources using using an alarm system **(60-90 minutes)**

Challenge: How to mitigate vandalism at the borehole & reduce down-time

H&D Chapter Collaboration: Vienna & Harare

Objectives 1: Setting up the prototype & testing using different variable conditions

Objective 2: Send feedback to the remote chapters in video format

SESSION 2

Goal : Fetching water using a real-time clock module **(60-90 minutes)**

Challenge: How to save time by accessing water a scheduled intervals

H&D Chapter Collaboration: Amsterdam & Harare

Objectives 1: Setting up the prototype & testing using different variable conditions

Objective 2: Send feedback to the remote chapters in video format

SESSION 3

Goal : Building a smart tap using an ultra-sonic sensor **(60-90 minutes)**

Challenge: To sanitize manual shared water taps by making them contact-less

H&D Chapter Collaboration: Pittsburgh & Harare

Objectives 1: Setting up the prototype & testing using different variable conditions

Objective 2: Send feedback to the remote chapters in video format

Start time: 1:30 pm

End time: 2:30 pm

DEMO DAY
Timeline

BEFORE

10 minutes : Opening Remarks
10-15 minutes: Guest of Honor Speech
10 minutes: About our initiative (introducing other chapters)
10 minutes: Workshop Overview & Results

DEMO TIME

Demo 1.1 : Fetching underground water using a simple button
Demo 1.2: Mitigating water usage using a soil moisture
Demo 1.3: Monitoring water usage using an LCD output
Demo 1.4: Securing the community borehole using using an alarm
Demo 1.5: Fetching water using a real-time clock module
Demo 1.6: Building a smart tap using an ultra-sonic
Duration: 1 – 2.5 hours

AFTER

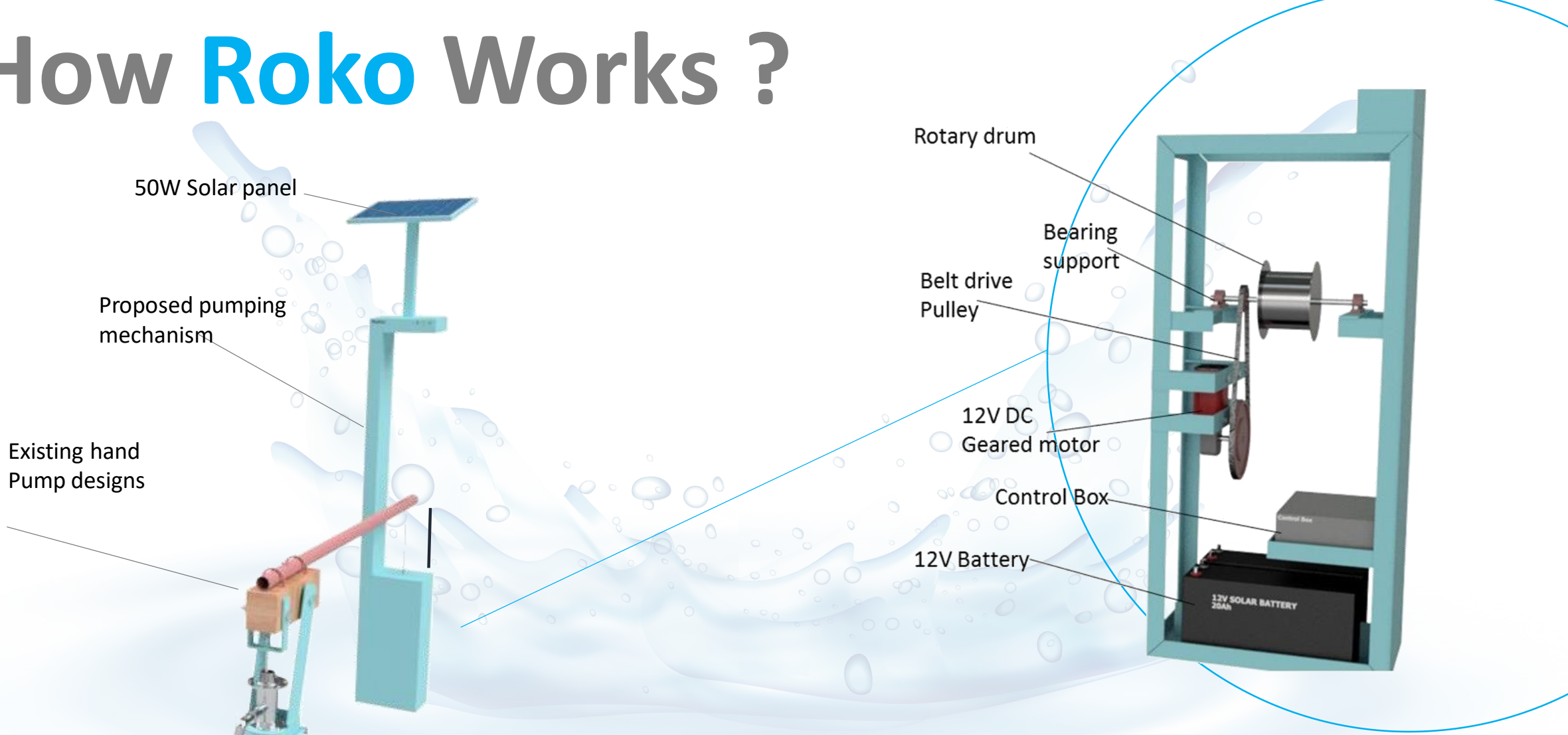
10 minutes: Closing Remarks
Till midnight : Cocktail Party

Start time: 10:30 pm **End time: 3:30 pm**

Demo Live-stream :

Online presentation of the contributions from each chapter, as their work is tested at the community borehole via live streaming.

How Roko Works ?



The Design of the solar powered mechanism is centered around the existing bush pumps found in Zimbabwe. The goal is to automate the hand pumping effort required, using a RFID tag, the user actuates mechanism that draws down the hand pump handle during up stroke and releases for the down stroke. Using a 50 Watt solar power unit, the mechanism converts solar energy to mechanical energy, allowing the user to tap underground water using solar energy. With a web & mobile dashboard we're also creating an awareness in the community regarding water availability & usage from the underground water aquifer, which is finite water resource.

Pilot Area Map

Pre-workshop Budget: Roko Demo unit Fabrication
Start Date: 10 May

	Required Items	Unit Cost	Quantity	Total Cost
1	Material Cost: Framework + Housing	$105.00	1 demo unit	$105.00
2	Fabrication Cost	$95.00	1 demo unit	$95.00
3	Solar Power Unit	$70.00	1 demo unit	$70.00
4.	Control Unit	In-stock	In-stock	In-stock
5.	Logistics (From Manufacturer to site)	$20.00	1 demo unit	$20.00
	Total Cost			**$290.00**

Personal Budget

	Required Items	Unit Cost	Quantity	Total Cost
6	Transport (Harare to Vic Falls)	$40.00	1 personnel	$40.00
7	Accommodation	$60.00	x 3 months	$180.00
8.	Monthly Allowance	$50.00	(May to July)	$150.00
	Total Cost			**$370.00**

Workshop Budget: 2 days

	Required Items	Unit Cost	Quantity	Total Cost
1	chairs & tables	$40.00/day	2 days	$40.00
2	Refreshments snacks	$100.00	20 people	$100.00
5.	Projector hiring	$30.00	2 days	$30.00
6.	Site rental fee	$55.00/day	2 days	$110.00
	Electronic Dev kits hiring (x 3)	$40.00/day	2 days	$80.00
6	Internet connection (40gb)	$60.00	2 days	$60.00
	Tent hiring (5m x 8m)	$75/day	2 days	$150.00
	Total Cost			**$570.00**
	Grand Total			**$1 230.00**

Budget Note:

The budget that has been compiled is a bootstrap budget set by leveraging the assistance of well-wishers who have shown great interest for the event after engaging them using the abstract that was prepared.

In order to make impact at a scale & for the innovation to attain the much needed recognition, the strategy is to start as early as possible with the first pre-workshop activity being the fabrication of the Roko demo unit. This will serve as technology validation in terms of the viability of the innovation to solve the water crisis in Harare, where the majority of communities relay on hand-powered Boreholes. This pre-activity will also serve as a proof of concept and a build up from the previous old version, so that prospective partners can come onboard in making the workshop event as a landmark where H&D participants in different chapters came together & collaborated their efforts to solve the water crisis affecting Harare citizens.

Potential Stakeholders that can partner for the workshop after building the demo unit

Stakeholder	Email	Cell/Tell Number	Key Leads : Must Watch
The City of Harare	cohweb@hararecity.co.zw	0478181019	https://fb.watch/5h0vg10yOn/
World Health Org	gasasiraa@who.int	+263 772 155 629 - 632	
UNICEF	harare@unicef.org	+263 242 703941/2	
HIVOS ZIMBABWE	rosaf@hivos.co.zw		
Welthunger		+(49)02282288127	https://www.welthungerhilfe.org/our-work/focus-areas/water-sanitation-and-hygiene/
WorldVision	info@worldvision.nl	+31 (0)33-4643444	
IRCWASH	https://www.ircwash.org/contact-us	**+31 70 304 4000**	https://www.ircwash.org/about

Other Potential Partners

Oxfam

World Vision

HARARE CITY COUNCIL

Hivos people unlimited

ZHRC ZIMBABWE HUMAN RIGHTS COMMISSION For Human Dignity

CRS CATHOLIC RELIEF SERVICES

magamba

ZENZELE : KHULUMA USENZA ORAP W.O. 26/81

B2C IDEAS TO MARKET

ĊOWORKING

UNDP

Internet Society Zimbabwe Chapter

Save the Children

MOTO REPUBLIK

ZIMPLATS Member of the Implats Group

Zimbabwe National Water Authority ZINWA WATER IS LIFE EVERY DROP COUNTS

unicef for every child

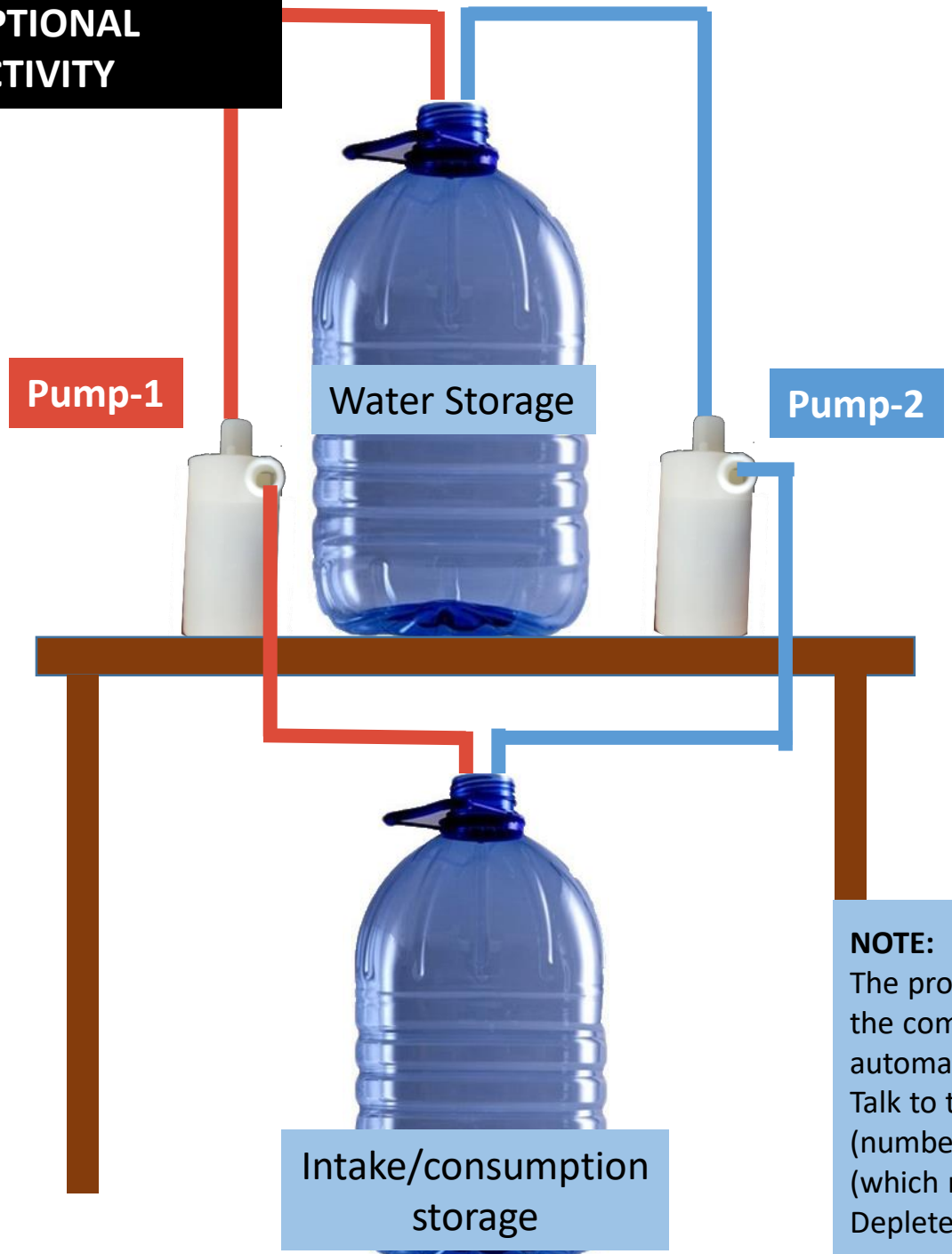
welt hunger hilfe For a world without hunger

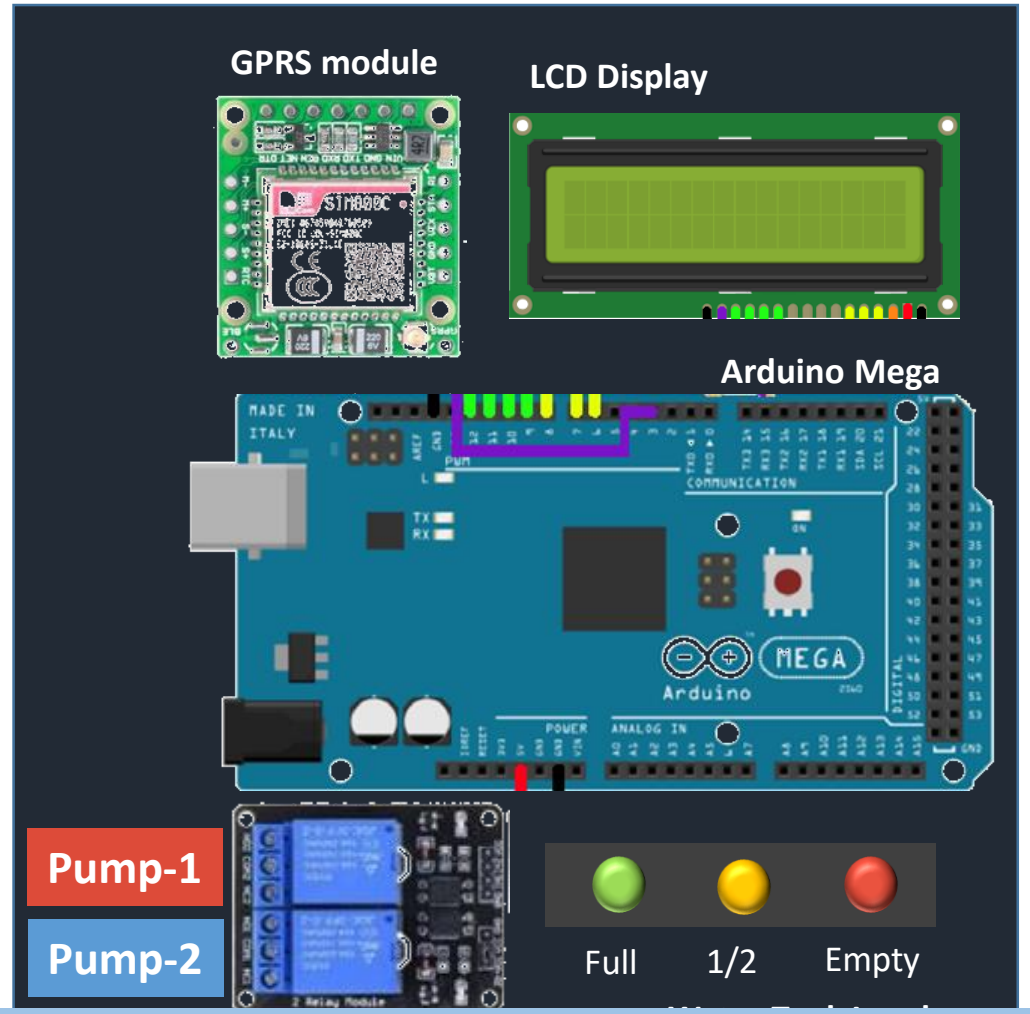
USAID FROM THE AMERICAN PEOPLE

NetOne The World In One

FAO Food and Agriculture Organization of the United Nations

OPTIONAL ACTIVITY

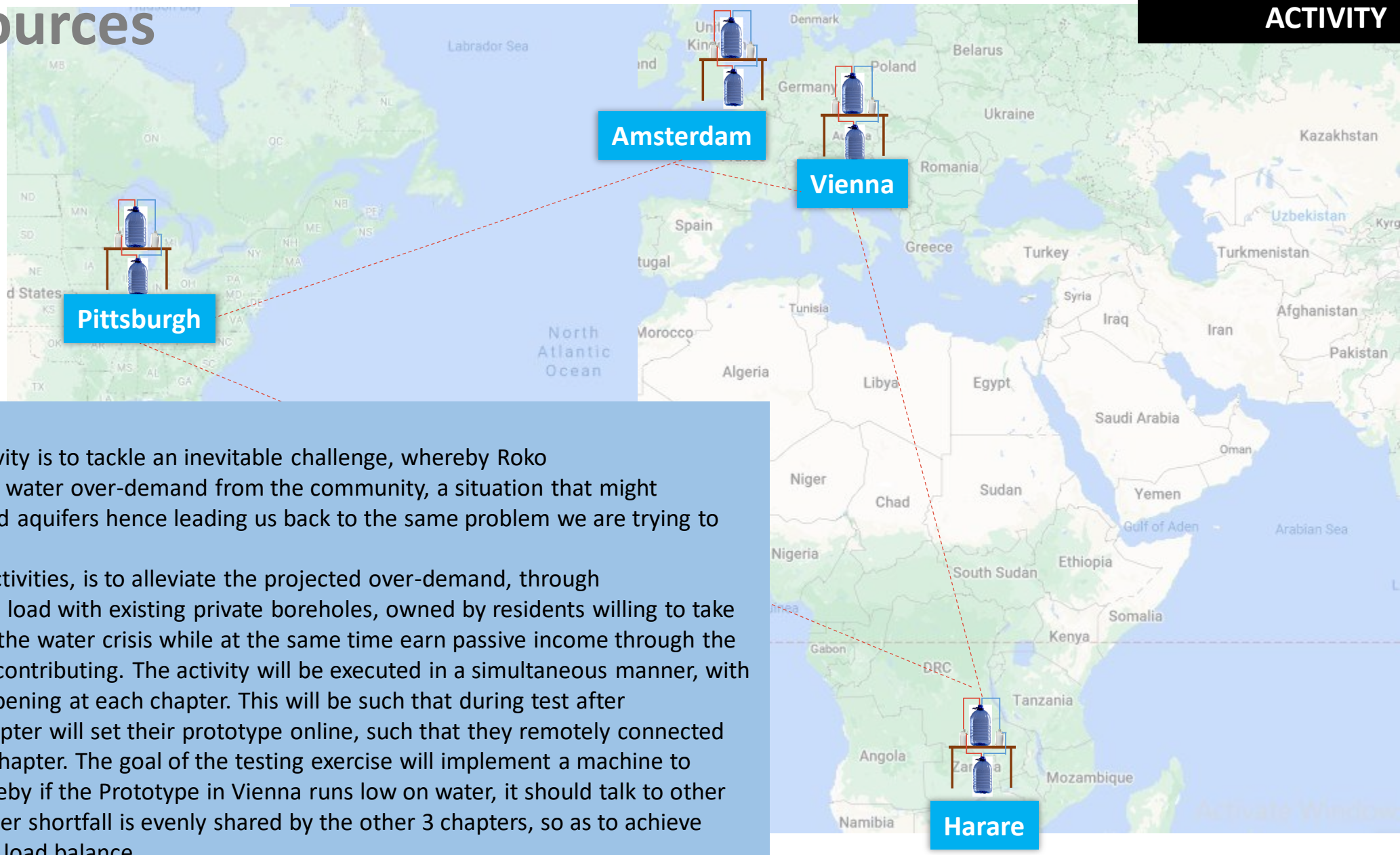




NOTE:
The prototype set up represents a water storage facility, whereby water consumption by the community is simulated by PUMP-1 whilst the water intake is simulated by **PUMP-2** automatically using an embedded source used to determine the deficient amount of water, and then Talk to the other 3 prototypes in the other chapters. The deficient amount of water is divided by 3 (number of prototypes) and the simulation executed drawing water the bottom container (which represents the source of intake flow) to the above container (which represents the Depleted water storage facility)

Connected Water Sources

OPTIONAL ACTIVITY



NOTE:

The purpose of this activity is to tackle an inevitable challenge, whereby Roko Technology might face a water over-demand from the community, a situation that might deplete the underground aquifers hence leading us back to the same problem we are trying to Solve.

Hence the goal of the activities, is to alleviate the projected over-demand, through a shared water demand load with existing private boreholes, owned by residents willing to take Part in the fight against the water crisis while at the same time earn passive income through the Water that they will be contributing. The activity will be executed in a simultaneous manner, with The same activities happening at each chapter. This will be such that during test after end of activity each chapter will set their prototype online, such that they remotely connected To each other at every chapter. The goal of the testing exercise will implement a machine to machine protocol whereby if the Prototype in Vienna runs low on water, it should talk to other Prototypes such the water shortfall is evenly shared by the other 3 chapters, so as to achieve A shared water demand load balance

NB: Activity timeline draft is work in progress